MERRIMACK RIVER FLOOD CONTROL

OPERATION AND MAINTENANCE MANUAL

FOR

FLOOD PROTECTION WORKS

LINCOLN, NEW HAMPSHIRE

EAST BRANCH, PEMIGEWASSET RIVER

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

MARCH 1961

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FOREWORD

The successful functioning of flood protection works is not assured solely by construction of a system of dikes, dike restoration, and channel excavation. If the system is to perform the functions for which it was designed, it must be carefully maintained during periods of normal river stages and properly operated during flood periods.

The need for proper maintenance cannot be too highly stressed in view of the fact that large damages may be incurred through failure of a critical element in flood time, caused by deterioration or damage that would have been eliminated by proper maintenence.

Necessary maintenance and proper operation require that responsible local persons have a thorough understanding of the functions of the various units of the system and the recommended methods of maintaining the system and operating it during flood emergencies. It is the purpose of this manual to provide complete information so that all parties may fully understand their responsibilities in maintaining and operating the flood protection system in accordance with the regulations prescribed by the Secretary of the Army as amplified by this manual.

The Flood Control Regulations for Maintenance and Operation of Flood Control Works quoted herein were approved by the Acting Secretary of War on 9 August 1944. Upon establishment of the Department of Defense, the improvement of rivers and harbors and other waterways for flood control and other purposes, formerly under the jurisdiction of the Secretary of War, became the responsibility of the Secretary of the Army. References therein to the Secretary of War and War Department shall be construed to mean, respectively, the Secretary of the Army and the Department of the Army. Where reference is made to the District Engineer in the Regulations included in this manual, it shall be construed to mean the Division Engineer, U. S. Army Engineer Division, New England.

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SECTION I

INTRODUCTION

1. AUTHORIZATION

Construction of the repair and restoration of existing flood control dike at Lincoln, New Hampshire, was authorized by the Chief of Engineers on March 16, 1960 pursuant to authority under the Flood Control Act approved August 18, 1941, as amended (Public Law 99, 84th Congress, approved June 23, 1955).

2. LOCATION

The project is located in northwestern New Hampshire on the East Branch of the Pemigewasset River in the Town of Lincoln. The East Branch of the Pemigewasset River joins with the Pemigewasset River in North Woodstock, New Hampshire approximately one mile southwest of Lincoln and 170 miles upstream of the mouth of the Merrimack River. Lincoln, New Hampshire is situated in the upper watershed of the Merrimack River Basin, 80 miles north of Concord, New Hampshire and 150 miles northwest of Boston, Massachusetts

3. DESCRIPTION OF PROJECT

The project extends from the Diversion Dam of the Franconia Paper Company for a distance downstream of approximately 1450 feet along the west (right) bank of the East Branch of the Pemigewasset River. The major project components consist of 1350 feet of channel excavation, 230 feet of new flank dike and approximately 1400 feet of existing dike restoration including 3 to 5 ton cover stone set on a slope of 1 vertical on 2 horizontal.

4. PROTECTION PROVIDED

The project will generally provide complete protection for flood flows up to 30,000 c.f.s. This corresponds to the record flood of October 1959. The design grade of dikes provides three feet of freeboard above the stages of the 30,000 c.f.s. flow.

5. CONSTRUCTION HISTORY

Construction of the Repair of Flood Control Dike was initiated in July 1960 and was completed in December 1960. The project was constructed by A. Arcaro & Sons, Inc., of Franklin, Massachusetts. Approximately 5,500 square yards of quarry stone blocks thirty

inches thick weighing a minimum of 3 tons to as much as 5 tons per block were placed as cover stone on the river face slope of the dike. Approximately 3400 cubic yards of bedding stone excavated from the river channel was used beneath the cover stone and as a rockpile face for the new flank dike. The Federal cost of the project was approximately $120,000.

6. PLANS

A reduced size set of drawings showing the project as actually constructed is included as Appendix E.

SECTION II

LOCAL COOPERATION REQUIREMENTS

7. FLOOD CONTROL ACTS

Section 3 of the Flood Control Act approved June 22, 1936 (Public Law No. 738, 74th Congress) provides, "That hereafter no money appropriated under authority of this Act shall be expended on the construction of any project until States, political subdivision thereof, or other responsible local agencies have given assurances satisfactory to the Army that they will:

(a) Provide without cost to the United States all lands, easements, and rights-of-way necessary for project construction;

(b) Hold and save the United States free from damages due to the construction works;

(c) Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army."

The above "abc" requirement of local cooperation for projects authorized under Public Law 99, 84th Congress, have been administratively determined by the Chief of Engineers to be a prerequisite to repair or restoration work where benefits are primarily of a local nature.

8. ASSURANCES

On March 8, 1960 at a town meeting, the Town of Lincoln voted to approve the proposed local protection project for the Restoration of the Flood Control Dike at the Franconia Paper Company, and authorized the Selectmen to enter into, and execute the Assurances as described above. Copy of the formal assurances are included as Appendix B.

SECTION III

GENERAL REGULATIONS

9. PURPOSE OF THIS MANUAL

The purpose of this Manual is to present detailed information to be used as a guide in complying with "Flood Control Regulations - Maintenance and Operation of Flood Control Works" as approved by the Acting Secretary of War on 9 August 1944, and published in this volume as Appendix A. In executing assurances of local cooperation, the Town has agreed to maintain and operate the completed works in accordance with those regulations. The regulations are intended to cover all local protection projects constructed by the Department throughout the United States, are general in nature, and obviously cannot give detailed instructions for the maintenance and operation of a specific project. The details set forth in this Manual for maintenance and operation of the Lincoln project are intended to supplement the regulations to permit obtaining all the benefits and protection against floods for which the project was designed. Failure to maintain and operate the project as required by the regulations and as detailed herein can cause severe property losses and loss of life and can result in an irreparable loss of confidence in the flood protection system by citizens who have invested their funds on the basis of the protection which it provides.

10. GENERAL RULES AND REGULATIONS

Paragraph 208.10 (a) of the regulations prescribed by the Secretary of War gives general rules for the maintenance and operation of structures and facilities constructed by the United States for local flood protection. Applicable portions are quoted below to avoid the necessity for cross reference and are further defined by remarks under each quotation.

"(1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits."

These requirements cannot be overstressed, and the Town authorities must make adequate provisions for funds, personnel, equipment, and materials to allow for the proper maintenance and operation of the flood protective works.

"(2) The State, political subdivision thereof, or other responsponsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations

prescribed by the Secertary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the 'Superintendent,' who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during the periods of low water, all without cost to the United States."

The committee should be composed of competent members, preferably men experienced in engineering or construction work of a nature similar to the flood protection works. The committee must be given broad authority to carry out its responsibilities. The name, address, and office and home telephone numbers of the Superintendent, and any changes thereof, shall be promptly furnished the Division Engineer.

"(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times."

Approximately 200 sand bags and tools, such as picks and shovels, for five men should be obtained and held in reserve to meet any ordinary emergency that may occur during flood periods. Borrow pits for embankment materials should be secured and sources or where to obtain additional supplies of materials, tools, and equipment should be well established in order that these articles can be obtained quickly in case of an emergency.

"(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities."

The disposal of rubbish, erection of fences, or barriers, or any form of trespassing on the project shall be prohibited.

"(5) No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representatives that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissable under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction

acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work."

Any contemplated improvements or alterations as outlined above must be submitted to the U.S. Army Engineer Division, Waltham, Massachusetts, and the approval of the Division Engineer obtained prior to the Town authorizing the work. All requests for approval shall be in writing and complete drawings in duplicate, one set of which shall be in reproducible form, must be submitted along with a full description of the work intended. The Town will be held responsible for obtaining prior approval from the Corps of Engineers for any improvements or alterations proposed by itself, private parties or any public parties. The Town shall furnish the Division Engineer as-built drawings, in duplicate, of the completed work.

"(6) It shall be the duty of the Superintendent to submit a semi-annual report to the District Engineer covering inspection, maintenance, and operation of the protective works."

See paragraph 13 of this Manual for instructions on submitting reports.

"(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works."

The Division Engineer or his representatives will make periodic inspections of the protective works to determine if the project is being properly maintained and operated by the Town.

"(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made."

The Town should maintain the facilities and keep them in good repair and not wait for the Division Engineer to call such matters to its attention. Upon request, the Division Office will advise the Town how to make any major repairs to the facilities.

"(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods."

The Town should formulate plans and negotiate agreements with local organizations and companies, who are operating facilities connected with the protective works, to insure that their activities will be properly coordinated with the Superintendent's organization during flood periods.

"(10) The War Department will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations."

The flood control committee should familiarize itself with the contents of this manual. The Town authorities are encouraged to call on the Division Office of the Corps of Engineers for any additional advice or instructions required by them in carrying out the Town's obligations for maintaining any operating the flood protection facilities.

11. MAINTENANCE

a. The word "maintenance" as used in this manual applies to the upkeep, repair and care of the work constructed by the United States and turned over to the Town of Lincoln. If the work is neglected there will be deterioration and possible failure in flood time when there is dire need of dependable protection.

b. Satisfactory and dependable operation depends on constant maintenance. The organization that performs maintenance must be familiar with various parts of the system and will be in a position to use them effectively in time of stress.

c. Maintenance includes regular inspection of the entire system. The purpose of an inspection is to detect any deterioration or faulty operation that indicates a need for repair or replacement.

d. Each of the major features of the project is discussed separately. Particular emphasis is placed on those points which, based on experience with special projects features, require special attention.

12. OPERATION

a. Operation in this manual refers to the actual use of the various features of the protection works during flood periods. It is intended that the procedure outlined herein will be sufficient to insure protection from floods to the design stage. However, advice relative to operation may be obtained at any time from the Engineering Division of the New England Division Office.

b. When abnormal river flows and stages are expected it is important that the Superintendent make immediate decisions and take prompt action and that he have the authority to carry out his decisions.

c. To insure correct operation it is essential that at least one person (preferably 2 or 3) be familiar with all phases of the flood protection works, know when to initiate the sandbag closure, know when to initiate gate operation at the intake structure, know just what supplies and transport are on hand, and know what men and tools can be mobilized for the patrolling and repair work.

d. It will be to the advantage of the Town to negotiate agreements with private owners and companies to operate and maintain project features that are directly related to facilities and property of those parties. However, the Corps of Engineers will look only to the Town for maintenance and operation of the project since the Town executed assurances of local cooperation.

13. REPORTS

a. The regulations prescribed by the Secretary of the Army call for semi-annual reports to be submitted by the Superintendent to the Division Engineer, covering inspection, maintenance and operation. Inspection of the flood protective facilities shall be made immediately prior to flood seasons, immediately following floods, and otherwise at intervals not exceeding 90 days as required by the regulations. Whereas spring and autumn are the seasons in which the majority of floods have occurred, floods can occur in any month of the year.

b. To assist the Superintendent in making his inspections and reports, sample forms have been prepared and are included in Appendix C. The Superintendent shall have additional copies printed for use in submitting his reports.

c. The semi-annual reports shall be submitted in triplicate to the Division Engineer each February and August. The reports will be submitted in letter form with copies of the inspection forms covering the inspections made during the period of the report. The reports shall cover the following points:

(1) A description of the maintenance work performed in the preceding six months.

(2) The number and classification of men working on maintenance, regularly and intermittently.

(3) Description of any work performed by contract on the repair or improvement of the project.

(4) Description of use or operation of the system during the period being reported.

(5) Suggestions relative to public cooperation and comments concerning public sentiment on the protection obtained are considered pertinent and desirable data for inclusion in the report, but such data are not required.

SECTION IV

CHANNEL WORK

14. DESCRIPTION

The channel work accomplished by the Corps of Engineers consists of minor channel excavation and the removal of cobbles and boulders from the northwestern portion of the river channel between the dam and a point opposite Station 14+65 on the base line and to the southeast of a line 10 feet to the southeast of the toe of the cover stone.

Cobbles and boulders, six inches and larger in maximum dimension, removed from the channel were utilized as bedding stone for the rockfill cover stone on the river side face of the dike. Material finer and smaller than six inches was used in fillets and other places where space was limited.

15. MAINTENANCE

Paragraph 208.10(g)(1) of the prescribed regulations sets forth rules for the maintenance of channels and floodways. These rules are quoted below, followed by brief comments on the particular applicability of these rules to the Lincoln project.

"Channels and floodways.- (1) Maintenance. - Periodic inspections of improved channels and floodways shall be made by the Superintendent to be certain that:

"(i) The channel or floodway is clear of debris, weeds, and wild growth."

All debris and growth which tend to restrict the channel shall be removed promptly.

"(ii) The channel or floodway is not being restricted by the depositing of waste materials, building of unauthorized structures or other encroachments."

Dumping of waste materials or any types of encroachment on the channel shall be prohibited and prompt steps shall be taken to remove or have removed any such encroachments.

"(iii) The capacity of the channel or floodway is not being reduced by the formation of shoals."

Shoal areas should be removed but care should be exercised that slopes of the channel and existing banks are not undercut. Existence of shoal areas will be apparent from inspections during time of low flow.

"(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of bank has occurred."

Banks damaged by rain or wave wash or sloughing shall be repaired promptly, using bankrun gravel and rock similar to that used in their original construction.

"(v) Riprap sections and deflection dikes and walls are in good condition."

Rockfill slope protection must be maintained in good condition to resist erosion. Any loss of rock due to slides, erosion or vandalism must be promptly replaced. Periodic checks should be made of the stone slope protection, movement or loss of stone, and prompt corrective action taken.

"(vi) Approach and egress channels adjacent to the improved channel or floodway are sufficiently clear of obstructions and debris to permit proper functioning of the project works."

In order for this project to function properly and as designed, the channel of the East Branch of the Pemigewasset River downstream from the project must be maintained in such condition that it is capable of carrying flood flows and not cause the river to back up, thus nullifying the effect of the improved channel. This is particularly true of the river channel immediately downstream of the project.

"Such inspection shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days. Immediate steps will be taken to remedy any adverse conditions disclosed by such inspections. Measures will be taken by the Superintendent to promote the growth of grass on bank slopes and earth deflection dikes. The Superintendent shall provide for periodic repair and cleaning of debris basins, check dams, and related structures as may be necessary."

16. OPERATION

Paragraph 208.10 (g) (2) of the prescribed regulations gives rules for operation of channels and floodways. These rules which are quoted below are self-explanatory and require no amplification with regard to the Lincoln project.

"(2) Operation. - Both banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or by wave wash. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become lodged against the bank

shall be removed. The improved channel or floodway shall be thoroughly inspected immediately following each major high water period. As soon as practicable thereafter, all snags and other debris shall be removed and all damage to banks, rip-rap, deflection dikes and walls, drainage outlets, or other flood control structures repaired."

17. EMERGENCY REPAIR MEASURES

Rules and instructions for emergency repair measures for the dikes as given in paragraph 21 are equally applicable to emergency repairs of the channel.

SECTION V

DIKES

18. DESCRIPTION

The dikes constructed by the Corps of Engineers consist of a new flank dike and the restoration of an existing log crib dike.

a. Flank Dike - The flank dike is located at the west abutment of the Diversion Dam and extends north for a distance of approximately 230 feet to meet with high ground. The dike is constructed of earth fill with side slopes of 1 vertical on 2 horizontal. The riverside slope is faced with two feet of bedding stone and the landslide slope is constructed of earth fill. The top width of the dike is sixteen feet and constructed to be utilized as an access road to the existing intake structure. The top grade of the dike, at elevation 837.0 mean sea level, provides three feet of freeboard above the project design flood of 30,000 c.f.s. Details of the dike are shown on the plans included as Appendix E.

b. Dike Restoration - The restoration of the existing log crib dike starts at the west abutment of the Diversion Dam and extends downstream along the west bank of the East Branch of the Pemigewasset River approximately 1450 feet. The dike is constructed of 3 to 5 ton cover stone placed on bedding stone with a riverside face slope of 1 vertical on 2 horizontal. The bedding stone which was excavated from the river channel, was placed directly against and upon the existing log crib dike. The cover stone placed upon the bedding stone was obtained and trucked to the site from a quarry. The cover stone is approximately 30 inches thick and rectangular in shape with various lengths and widths, such as 3 x 5 feet, 5x 5 feet and 3 x 7 feet. The weight of the cover stones vary from 3 to 5 tons with some blocks weighing as much as 7 tons. The landslide face of the dike consists of bedding stone sloped 1 vertical on 2 horizontal to meet the existing ground. The top of the dike is constructed of cover stone at least 3 feet wide with top elevations that vary along the length of the dike to provide 3 feet of freeboard above the project design flood of 30,000 c.f.s. Details of the dike are shown on the plans included as Appendix E.

19. MAINTENANCE

Paragraph 208.10 (b) (1) of the prescribed regulations sets forth rules for the maintenance of levees. These rules apply equally to earth dikes, and applicable portions are quoted below. Following this, points that apply particularly to the Lincoln project are discussed.

"Levees. - (1) Maintenance. - The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, to exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out and, further, to be certain that:

"(i) No unusual settlement, sloughing or material loss of grade or levee cross section has taken place;

"(ii) No caving has occurred on either the land side or the river side of the levee which might affect the stability of the levee section;

"(iii) No seepage, saturated areas, or sand boils are occurring;

"(iv) _____ Not applicable _____.

"(v) _____ Not applicable _____.

"(vi) No revetment work or riprap has been displaced, washed out or removed;

"(vii) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

"(viii) Access roads to and on the levee are being properly maintained;

"(ix) _____ Not applicable _____.

"(x) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

"(xi) There is no unauthorized grazing or vehicular traffic on the levees;

"(xii) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning during time of emergency.

"Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days; and such intermediate times as may be necessary to insure the best possible care of the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent."

b. Any unusual settlement, sloughing or caving should be corrected to restore the original dike grades. No major repair work shall be made without prior approval of the Division Engineer, in order that such repairs that may be necessary will not adversely affect the functioning of the protective facilities.

c. Inspections of the dike shall be made during and after periods of high water, as it is at such times that any weak spots will be discovered that might otherwise be overlooked.

20. OPERATION

a. Paragraph 208.10 (b) (2) of the prescribed regulations sets forth rules for the operation of the levees. These rules apply equally to earth dikes and are quoted below. Following these, a few of the points which apply particularly to the Lincoln project will be discussed.

"(2) Operation. During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

"(i) There are no indications of slides or sloughs developing;

"(ii) Wave wash or scouring action is not occurring;

"(iii) No low reaches of levee exist which may be overtopped;

"(iv) No other conditions exist which might endanger the structure.

"Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section.

b. Operation in reference to the use of the dikes may be at a time of moderately high water, such as a spring freshet, or may be when unusual conditions indicate the possibility of dangerous flood heights. Floods on the East Branch of the Pemigewasset River do not allow much time in which to make extensive preparations. Prompt action in starting work is of the utmost importance.

c. Requirements for patrolling the dikes depend on the depth of water on the river side of dike. Stages in this manual refer to depth of water on the crest of the Diversion Dam. Elevations refer to mean sea level datum. For reference, the crest of the dam is at elevation 823.7 and the top of the wood sheeting adjacent to the gate of the intake structure on the west abutment of the Diversion Dam is at elevation 835.7.

(1) Patrolling the dikes should start when water reaches a stage of 4 feet above the crest of the dam, and should continue until the flood has reached its peak and receded below the stage of 4 feet.

(2) Patrolmen should be thoroughly instructed as to their duties, what they are to watch for, and the exact limits of their beat. On each journey of inspection they should carefully examine both slopes of the dikes for seepage or wetness on landside slope, sand boils on landside of dike, wave wash or scouring on riverside slope, and indications of slides or sloughs on either slope.

(3) All unauthorized traffic on the dikes should be stopped at once, and patrolmen should be instructed to keep people off the dike unless they can show passes or credentials authorizing their presence.

21. EMERGENCY REPAIR MEASURES

a. Scours. - Careful watch should be maintained of the dike for indication of scouring. If any indication of scouring is observed, soundings should be taken to observe the amount and progress of the scour. Sandbagging or dumped rock will generally afford the most practicable means of combatting this condition. The open ends of sandbags so used must be sewed or tied after filling with earth.

b. Wave wash. - Wave action may cause displacement of riprap and wash-out of earth materials on the riverside slope of the dike. Well-sodded slopes will usually withstand waves from a storm of about an hour's duration without serious damage. An attack over a longer period may become serious and the slopes should be protected by sacking or equivalent means. The extent of washes can be determined by wading along the attacked slope. Sandbags should be placed in the erosions in as effective a manner as possible, carrying the protection well above the action of waves. Sandbags used for this purpose require only about one-half cubic foot of material and should be sewed or tied. The aim is to obtain a maximum of coverage with only sufficient weight to hold the sack in place.

c. Sand Boils. - (1) General. - A sand boil is the result of a transfer of pressure head and seepage from the river, through a pervious stratum near or at the surface, to the landside of the dike. This seepage under pressure tends to push its way to the surface and actually floats the material through which it flows. No harmful effect results provided the weight of the relatively impervious soil layer overlying the pervious stratum, in which the flow under pressure is occurring, is sufficient to counterbalance this pressure. When the soil stratum overlying the pervious layer is insufficient to counterbalance the upward pressure or when no such stratum exists, boils break through the surface on the landside wherever these weaknesses are present. The sand boil may discharge relatively clear water or the discharge may contain quantities of sand and silt, depending upon the magnitude of the pressure and the size of the boil.

(2) Effects of Sand Boils. - Sand boils can produce three distinctly different effects on the levee, depending upon the condition of flow under the levee. These three effects are illustrated in Appendix D. In Figure 1, Plate No. 1, the seepage flow develops a definite pipe or tube under the levee. This breaks out at the landside toe in the form of one or more large sand boils. Unless checked, this flow causes a cavern to be developed under the levee, resulting in subsidence of the levee and subsequent failure. This case can be most easily recognized by slumping of the levee crown. Figure 2, Plate No. 1, illustrates the case where seepage flows under pressure under the levee without following a defined path, as the case above. This flow results in one or more boils outcropping at or near the landside toe. The flow from these boils tends to undercut and ravel the slope, resulting in a sloughing of the slope. Evidence of this type of failure is found in undercutting and ravelling at the landside toe. Figure 3, Plate No. 1, shows a third type of effect of a sand boil. In this case, numerous small boils, many of which are scarcely noticeable, outcrop at or near the toe. While no boil may appear to be dangerous in itself, the consequence of the group of boils is to cause flotation of the soil, thereby reducing the shearing strength of the material at the

toe, where maximum shearing stress occurs, to such an extent that failure of the slope through sliding results.

(3) General Instructions for Handling Sand Boils. - All sand boils shall be watched closely. A sand boil which discharges clear water in a steady flow is usually not dangerous to the safety of the dike. However, if the flow of water increases and the sand boil begins to discharge material, corrective action shall be taken immediately.

(4) Method of Treatment. (a) The accepted method of treating sand boils is to construct a ring of sandbags around the boil, building up a head of water within the ring sufficient to prevent further movement of sand and silt. The accepted method of ringing a sand boil, shown on Plate No. II of Appendix D, is as follows:

1. The entire base of the sack ring is cleared of debris, in order to provide a watertight bond between the natural ground and the sack ring.

2. The sacks are then laid in a ring around the boil, with joints staggered, and with loose earth between all sacks.

3. The ring is carried only to a height sufficient to prevent material from being discharged. The ring should not entirely stop the flow of water, because of the probability of the excessive local pressure head causing additional ruptures of impervious strata and boils nearby.

4. A "V" shaped drain constructed of two boards, or a piece of sheet metal, is then placed near the top of the ring to carry off water.

(b) Actual conditions at each sand boil will determine the exact dimensions of the ring. The diameter and height of the ring depend upon the size of the boil, and the flow of water from it. In general, the following considerations should govern:

1. The base width should be no less that $1\frac{1}{2}$ times the contemplated height.

2. It is well to include weak ground near the boil within the ring, thereby preventing a break-through later.

3. The ring should be of sufficient size to permit sacking operations to keep ahead of the flow of water.

(c) Where many boils are found to exist in a given area, a ring levee of sand bags shall be constructed around the entire area and, if necessary, water pumped into the area to provide sufficient weight to counterbalance the upward pressure.

(d) Sloughs. - During prolonged high water stages, seeping and sloughing conditions on the landside slopes may occur. Such conditions should be observed closely as to progress of seepage up the landside slope and the amount of material that is being carried by seepage. If the seep velocity becomes great enough to cause, or probably cause, erosion or sloughing of the slope, a sandbag covering should be placed on the seeping area, beginning well out from the toe and progressing up the slope. The covering should extend several feet beyond the saturated area. If the material is obtainable, the affected area should be covered with brush, straw or similar permeable material to a depth of two to four inches before placing the sandbag cover. This will permit the seep water to get away while serving as a filter to prevent loss of earth from the dike. After the covering is placed, close observation should be maintained and additional layers of sandbags placed on the previous ones until the velocity of the seepage is reduced to a point at which the amount of material carried is negligible. Sacking sloughs are illustrated on Plate No. III of Appendix D.

(e) Raising existing earth dikes. - In an emergency, time and other conditions permitting, the grade of a dike can be safely raised three feet. The methods most commonly used for this purpose are outlined in the following paragraphs.

(1) Sandbag topping. - The sack ordinarily used for topping an earth dike is a grain or feed sack which holds 100 pounds of grain. Smaller sacks may be used if feed sacks are not available. Grain sacks, filled with about one cubic foot of earth, weighing about 100 pounds, will provide a unit about six inches high, one foot wide and two feet in length.

The sacks may be filled at the source of material and hauled to the dike or filled from stockpile or borrow areas at the dike; conditions determining the method employed. The same is true of filling; i.e., whether power or hand methods are used.

The open end of the sacks should always face upstream or toward the riverside of the dike and need not be sewed or tied. When the sack faces the river the loose end should be folded under and when facing upstream the loose end covered by the succeeding sack.

The front line of sandbags in the first layer should be laid parallel to the dike center line and remaining bags at right angles to the center line. The sandbags in the second layer are all laid at right angles to the center line, the third row similar to the first, etc., as shown on Plate No. IV, Appendix D. All sacks should be lapped about 1/3 each way and well mauled or tramped into place. The sacks should be filled to 2/3 their capacity when flattened out to facilitate proper placing and prevent bursting the sack when mauled or tramped into place.

Plate No. IV illustrated the progressive method of increasing the dike height and gives an approximation of the number of sacks required for dikes of various heights. Plate No. V shows pictures of model sack dike or topping.

A crew of 50 men should fill, carry and place approximately 1500 sacks per eight-hour day, all hand labor, when the source of material is within 150 feet of the point of placement. Production will depend on conditions at the site.

(2) Lumber and Sandbag Topping is the most satisfactory method of raising low reaches of earth dike in emergencies. The chief objection is the time required to install. In putting on this topping, as well as any other topping, a careful line of levels should be run and grade stakes set in advance unless the dike top follows a dependable grade-line. Two-by-four or two-by-six inch stakes should then be driven on the riverside of the crown six feet apart and one-by-twelve inch boards nailed to landside of the stakes. This wall, backed with a single tier of sandbags, will hold out at least one foot of water. If the second foot is necessary, the layers of bags will have to be increased in number and reinforced. Sandbags are laid substantially in the manner described in (1) above. The stakes should be driven at least three feet into the ground, leaving at least three feet out, which will, in extreme cases, hold a three-foot topping if properly braced behind the sandbags. Plate No. VI, Appendix D illustrates this method of raising a dike.

SECTION VI

SLUICE GATE STRUCTURE

22. DESCRIPTION

The existing sluice gate structure located on the west abutment of the Division Dam, maintained and operated by the Franconia Paper Company, is utilized for controlling water to a log pond by way of a diversion channel. The sluice gate is manually operated from the top of the abutment and has an invert elevation at 822.2 mean sea level.

23. MAINTENANCE

Normal maintenance as required for this type of structure should be performed. Adequate measures shall be taken to insure that the intake structure is kept free of trash, drift or debris that would interfere with the operation of the gate. The manually operated gate shall be examined, oiled, and trial operated at least once every 90 days.

24. OPERATION

Whenever high water conditions impend, the gate will be inspected and any object which might prevent closure of the gate shall be removed. During high river stages, the gate shall be closed as necessary to prevent the inflow of flood waters, via the diversion channel, from impounding the area behind the dikes and the property of the Franconia Paper Company.

APPENDICES

APPENDIX A

REGULATIONS PRESCRIBED BY THE SECRETARY OF WAR

TITLE 33—NAVIGATION AND NAVIGABLE WATERS

Chapter II—Corps of Engineers, War Department

PART 208—FLOOD CONTROL REGULATIONS

MAINTENANCE AND OPERATION OF FLOOD CONTROL WORKS

Pursuant to the provisions of section 3 of the Act of Congress approved June 22, 1936, as amended and supplemented (49 Stat. 1571; 50 Stat. 877; and 55 Stat. 638; 33 U. S. C. 701c; 701c–1), the following regulations are hereby prescribed to govern the maintenance and operation of flood control works:

§ 208.10 *Local flood protection works; maintenance and operation of structures and facilities*—(a) *General.* (1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits.

(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the "Superintendent," who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States.

(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times.

(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities.

(5) No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work.

(6) It shall be the duty of the superintendent to submit a semiannual report to the District Engineer covering inspection, maintenance, and operation of the protective works.

(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works.

(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made.

(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods.

(10) The War Department will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations.

(b) *Levees*—(1) *Maintenance.* The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out and, further, to be certain that:

(i) No unusual settlement, sloughing, or material loss of grade or levee cross section has taken place;

(ii) No caving has occurred on either the land side or the river side of the levee which might affect the stability of the levee section;

(iii) No seepage, saturated areas, or sand boils are occurring;

(iv) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged;

(v) Drains through the levees and gates on said drains are in good working condition;

(vi) No revetment work or riprap has been displaced, washed out, or removed;

(vii) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(viii) Access roads to and on the levee are being properly maintained;

(ix) Cattle guards and gates are in good condition;

(x) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

(xi) There is no unauthorized grazing or vehicular traffic on the levees;

(xii) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning durin times of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days, and such intermediate times as may be necessary to insure the best possible care of the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

(2) *Operation.* During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

(i) There are no indications of slides or sloughs developing;

(ii) Wave wash or scouring action is not occurring;

(iii) No low reaches of levee exist which may be overtopped;

(iv) No other conditions exist which might endanger the structure.

Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section.

(c) *Flood walls.*—(1) *Maintenance.* Periodic inspections shall be made by the Superintendent to be certain that:

(i) No seepage, saturated areas, or sand boils are occurring;

(ii) No undue settlement has occurred which affects the stability of the wall or its water tightness;

(iii) No trees exist, the roots of which might extend under the wall and offer accelerated seepage paths;

(iv) The concrete has not undergone cracking, chipping, or breaking to an extent which might affect the stability of the wall or its water tightness;

(v) There are no encroachments upon the right-of-way which might endanger the structure or hinder its functioning in time of flood;

(vi) Care is being exercised to prevent accumulation of trash and debris adjacent to walls, and to insure that no fires are being built near them;

(vii) No bank caving conditions exist riverward of the wall which might endanger its stability;

(viii) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged.

Such inspections shall be made immediately prior to the beginning of the flood season, immediately following each major high water period, and otherwise at intervals not exceeding 90 days. Measures to eliminate encroachments and effect repairs found necessary by such inspections shall be undertaken immediately. All repairs shall be accomplished by methods acceptable in standard engineering practice.

(2) *Operation.* Continuous patrol of the wall shall be maintained during flood periods to locate possible leakage at monolith joints or seepage underneath the wall. Floating plant or boats will not be allowed to lie against or tie up to the wall. Should it become necessary during a flood emergency to pass anchor cables over the wall, adequate measures shall be taken to protect the concrete and construction joints. Immediate steps shall be taken to correct any condition which endangers the stability of the wall.

(d) *Drainage structures*—(1) *Maintenance.* Adequate measures shall be taken to insure that inlet and outlet channels are kept open and that trash, drift, or debris is not allowed to accumulate near drainage structures. Flap gates and manually operated gates and valves on

drainage structures shall be examined, oiled, and trial operated at least once every 90 days. Where drainage structures are provided with stop log or other emergency closures, the condition of the equipment and its housing shall be inspected regularly and a trial installation of the emergency closure shall be made at least once each year. Periodic inspections shall be made by the Superintendent to be certain that:

(i) Pipes, gates, operating mechanism, riprap, and headwalls are in good condition;

(ii) Inlet and outlet channels are open;

(iii) Care is being exercised to prevent the accumulation of trash and debris near the structures and that no fires are being built near bituminous coated pipes;

(iv) Erosion is not occurring adjacent to the structure which might endanger its water tightness or stability.

Immediate steps will be taken to repair damage, replace missing or broken parts, or remedy adverse conditions disclosed by such inspections.

(2) *Operation.* Whenever high water conditions impend, all gates will be inspected a short time before water reaches the invert of the pipe and any object which might prevent closure of the gate shall be removed. Automatic gates shall be closely observed until it has been ascertained that they are securely closed. Manually operated gates and valves shall be closed as necessary to prevent inflow of flood water. All drainage structures in levees shall be inspected frequently during floods to ascertain whether seepage is taking place along the lines of their contact with the embankment. Immediate steps shall be taken to correct any adverse condition.

(e) *Closure structures*—(1) *Maintenance.* Closure structures for traffic openings shall be inspected by the superintendent every 90 days to be certain that:

(i) No parts are missing;

(ii) Metal parts are adequately covered with paint;

(iii) All movable parts are in satisfactory working order,

(iv) Proper closure can be made promptly when necessary;

(v) Sufficient materials are on hand for the erection of sand bag closures and that the location of such materials will be readily accessible in times of emergency.

Tools and parts shall not be removed for other use. Trial erections of one or more closure structures shall be made once each year, alternating the structures chosen so that each gate will be erected at least once in each 3-year period. Trial erection of all closure structures shall be made whenever a change is made in key operating personnel. Where railroad operation makes trial erection of a closure structure infeasible, rigorous inspection and drill of operating personnel may be substituted therefor. Trial erection of sand bag closures is not required. Closure materials will be carefully checked prior to and following flood periods, and damaged or missing parts shall be repaired or replaced immediately.

(2) *Operation.* Erection of each movable closure shall be started in sufficient time to permit completion before flood waters reach the top of the structure sill. Information regarding the proper method of erecting each individual closure structure, together with an estimate of the time required by an experienced crew to complete its erection will be given in the Operation and Maintenance Manual which will be furnished local interests upon completion of the project. Closure structures will be inspected frequently during flood periods to ascertain that no undue leakage is occurring and that drains provided to care for ordinary leakage are functioning properly. Boats or floating plant shall not be allowed to tie up to closure structures or to discharge passengers or cargo over them.

(f) *Pumping plants*—(1) *Maintenance.* Pumping plants shall be inspected by the Superintendent at intervals not to exceed 30 days during flood seasons and 90 days during off-flood seasons to insure that all equipment is in order for instant use. At regular intervals, proper measures shall be taken to provide for cleaning plant, buildings, and equipment, repainting as necessary, and lubricating all machinery Adequate supplies of lubricants for all types of machines, fuel for gasoline or diesel powered equipment, and flash lights or lanterns for emergency lighting shall be kept on hand at all times. Telephone service shall be maintained at pumping plants. All equipment, including switch gear, transformers, motors, pumps, valves, and gates shall be trial operated and checked at least once every 90 days. Megger tests of all insulation shall be made whenever wiring has been subjected to undue dampness and otherwise at intervals not to exceed one year. A record shall be kept showing the results of such tests. Wiring disclosed to be in an unsatisfactory condition by such tests shall be brought to a satisfactory condition or shall be promptly replaced Diesel and gasoline engines shall be started at such intervals and allowed to run for such length of time as may be necessary to insure their serviceability in times of emergency. Only skilled electricians and mechanics shall be employed on tests and repairs. Operating personnel for the plant shall be present during tests. Any equipment removed from the station for repair or replacement shall be returned or replaced as soon as practicable and shall be trial operated after reinstallation. Repairs requiring removal of equipment from the plant shall be made during off-flood seasons insofar as practicable.

(2) *Operation.* Competent operators shall be on duty at pumping plants whenever it appears that necessity for pump operation is imminent. The operator shall thoroughly inspect, trial operate, and place in readiness all plant equipment. The operator shall be familiar with the equipment manufacturers' instructions and drawings and with the "Operating Instructions" for each station. The equipment shall be operated in accordance with the above-mentioned "Operating Instructions" and care shall be exercised that proper lubrication is being supplied all equipment, and that no overheating, undue vibration or noise is occurring. Immediately upon final recession of flood waters, the pumping station shall be thoroughly cleaned, pump house sumps flushed, and equipment thoroughly inspected, oiled and greased. A record or log of pumping plant operation shall be kept for each station, a copy of which shall be furnished the District Engineer following each flood.

(g) *Channels and floodways* — (1) *Maintenance.* Periodic inspections of improved channels and floodways shall be made by the Superintendent to be certain that:

(i) The channel or floodway is clear of debris, weeds, and wild growth;

(ii) The channel or floodway is not being restricted by the depositing of waste materials, building of unauthorized structures or other encroachments;

(iii) The capacity of the channel or floodway is not being reduced by the formation of shoals;

(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of banks has occurred;

(v) Riprap sections and deflection dikes and walls are in good condition;

(vi) Approach and egress channels adjacent to the improved channel or floodway are sufficiently clear of obstructions and debris to permit proper functioning of the project works.

Such inspections shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days. Immediate steps will be taken to remedy any adverse conditions disclosed by such inspections. Measures will be taken by the Superintendent to promote the growth of grass on bank slopes and earth deflection dikes. The Superintendent shall provide for periodic repair and cleaning of debris basins, check dams, and related structures as may be necessary.

(2) *Operation.* Both banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or by wave wash. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become lodged against the bank shall be removed. The improved channel or floodway shall be thoroughly inspected immediately following each major high water period. As soon as practicable thereafter, all snags and other debris shall be removed and all damage to banks, riprap, deflection dikes and walls, drainage outlets, or other flood control structures repaired.

(h) *Miscellaneous facilities* — (1) *Maintenance.* Miscellaneous structures and facilities constructed as a part of the protective works and other structures and facilities which function as a part of, or affect the efficient functioning of the protective works, shall be periodically inspected by the Superintendent and appropriate maintenance measures taken. Damaged or unserviceable parts shall be repaired or replaced without delay. Areas used for ponding in connection with pumping plants or for temporary storage of interior run-off during flood periods shall not be allowed to become filled with silt, debris, or dumped material. The Superintendent shall take proper steps to prevent restriction of bridge openings and, where practicable, shall provide for temporary raising during floods of bridges which restrict channel capacities during high flows.

(2) *Operation.* Miscellaneous facilities shall be operated to prevent or reduce flooding during periods of high water. Those facilities constructed as a part of the protective works shall not be used for purposes other than flood protection without approval of the District Engineer unless designed therefor. (49 Stat. 1571, 50 Stat. 877; and 55 Stat. 638; 33 U.S.C. 701c; 701c-1) (Regs. 9 August 1944, CE SPEWF)

[SEAL] J. A. ULIO,
Major General,
The Adjutant General.

[F. R. Doc. 44-12285; Filed, August 16, 1944; 9:44 a. m.]

APPENDIX B

ASSURANCES OF LOCAL COOPERATION

ASSURANCE OF THE TOWN OF LINCOLN, NEW HAMPSHIRE

WHEREAS, the Congress of the United States, under the Flood Control Act approved August 18, 1941, as amended, has provided for "an emergency fund in the amount of $15,000,000.00 to be expended in flood emergency preparation; in flood fighting and rescue operations, or in the repair or restoration of any flood control work threatened or destroyed by flood, including the strengthening, raising, extending, or other modifications thereof as may be necessary in the discretion of the Chief of Engineers for the adequate functioning of the work for flood control"; and

WHEREAS, the flood control dike at Franconia Paper Company situated along the East Branch of the Pemigewasset River, Town of Lincoln, Grafton County, New Hampshire, requires restoration; and

WHEREAS, the Chief of Engineers has authorized the work consisting of dike restoration along the west bank of the East Branch of the Pemigewasset River by means of rock fill and heavy cover stone, channel clearing, construction of a flank dike to close off a ground saddle to the rear of the existing dike works and protective stone covering along the west abutment of the existing diversion dam; and

WHEREAS, said project is subject to the provisions of Section 3 of the Flood Control Act of 1936 that no money appropriated under authority of said act shall be expended on the construction of any project until states, political subdivisions thereof, or other responsible local agencies have given assurances to the Secretary of the Army that they will (a) provide without cost to the United States, all lands, easements, and rights-of-way necessary for the construction of the project; (b) hold and save the United States free from damages due to the construction works; (c) maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army; and

WHEREAS, the Town of Lincoln voted to approve the proposed local protection project for the Restoration of the Flood Control Dike at the Franconia Paper Company, and authorized the Selectmen to enter into, and execute an Assurance or other agreement in reference thereto, and to authorize the Selectmen to acquire any real estate interests for said project; and

WHEREAS, the Franconia Paper Company has undertaken and completed certain

repairs which will be utilized in part in the final restoration of the dike.

NOW, THEREFORE, the Town of Lincoln through its Board of Selectmen as heretofore authorized, hereby assures the United States of America that the Town of Lincoln will:

a. Provide without cost to the United States, all lands, easements, and rights-of-way necessary for the construction of the project.

b. Hold and save the United States of America free from damages due to the construction works.

c. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.

IN WITNESS WHEREOF, we, James L. MacDonald, Edward Levasseur, George M. McGee, Sr.

the Board of Selectmen of the Town of Lincoln, under authority granted at a Town meeting held March 8, 1960, have executed the within Assurance and caused the corporate seal of said Town of Lincoln to be affixed hereto this 2nd day of June, 1960.

TOWN OF LINCOLN

By James L. MacDonald
Edward Levasseur
George M. McGee Sr.

Board of Selectmen

TOWN OF LINCOLN RHODE ISLAND 1871

ACCEPTANCE

JUNE 14, 1960

The within Assurance is hereby accepted for and on behalf of the United States of America.

By _____
ALDEN K. STIRLEY
Brigadier General, U. S. Army
Division Engineer

APPENDIX C

INSPECTION REPORT FORM

FLOOD PROTECTIVE WORKS
EAST BRANCH, PEMIGEWASSET RIVER
LINCOLN, NEW HAMPSHIRE

INSPECTION REPORT

FOR PERIOD _____

1. Dike

a. Date inspected by Superintendent _____
b. Condition of slopes and top _____
_____
c. Are there any burrowing animal holes in dike? _____
d. Public use of dike
(1) Are there any paths on dike? _____
(2) Has right-of-way been used for dumping or storage of materials? _____
e. Describe deficiencies, including location, and corrective measures planned. _____
_____
_____
_____

2. Channel

a. Date inspected by Superintendent _____
b. General condition of channel _____
c. Has the capacity of the channel been reduced due to growth of vegetation, shoaling, or other encroachments? _____
d. General condition of stone slope protection _____
e. Has there been any removal of stone? _____
f. Has there been any movement of the derrick stone? _____
g. Describe deficiencies, including location, and corrective measures planned _____
_____
_____
_____

3. Sluice Gate

a. Date inspected by Superintendent _____
b. General condition of gate _____
c. Date examined, oiled and trial operated _____

3. Sluice Gate (cont'd)

d. Has intake structure been kept free of trash, drift or debris? _____

e. Describe deficiencies and corrective measures planned _____

_____

_____

_____

4. General

a. Have all deficiencies noted in previous Inspection Report been corrected? _____

b. Has any high water been experienced since the last Inspection Report? _____
If so, describe briefly, including dates, height of water, and effect on protective works. _____

_____

_____

_____

Submitted:

(Signed) _____
Superintendent

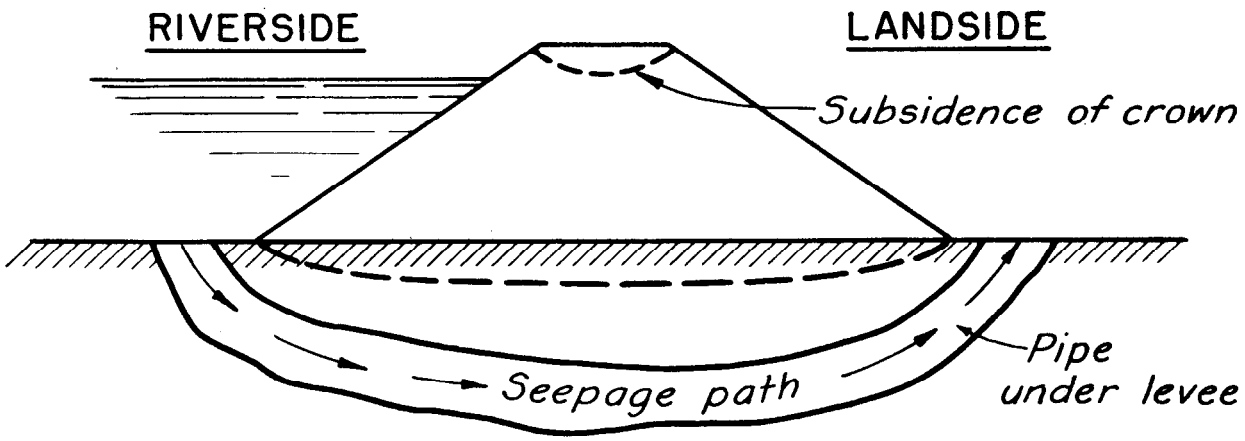
_____
(Date)

APPENDIX D

FLOOD EMERGENCY MEASURES

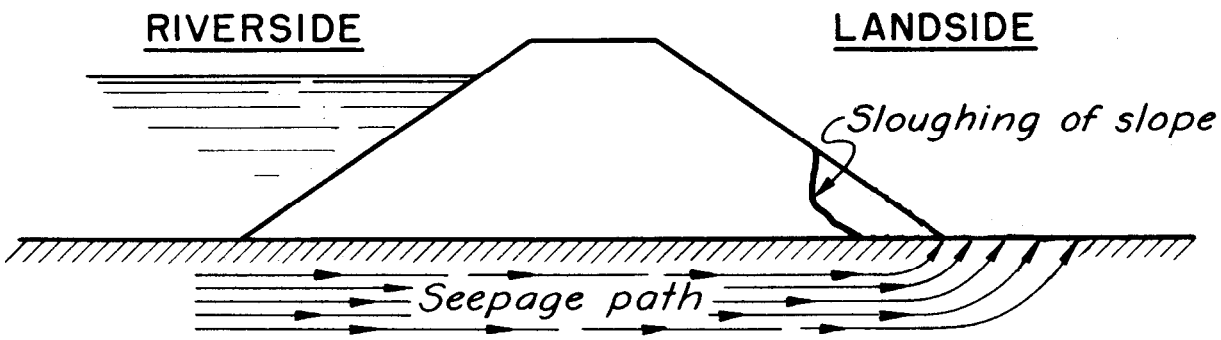
Plate No.	Title
I	Effect of Sand Boils
II	Sand Boil
III	Sacking Sloughs
IV	Sack Dike or Topping
V	Model Sack Dike or Topping
VI	Lumber and Sack Topping

EFFECTS OF SAND BOILS ON LEVEE



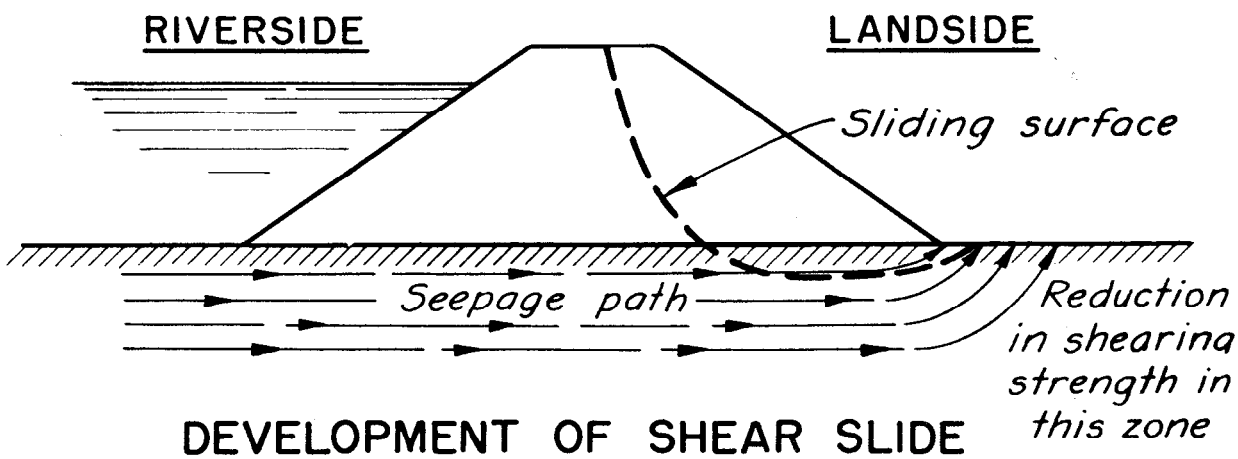
DEVELOPMENT OF PIPE UNDER LEVEE

Fig. 1



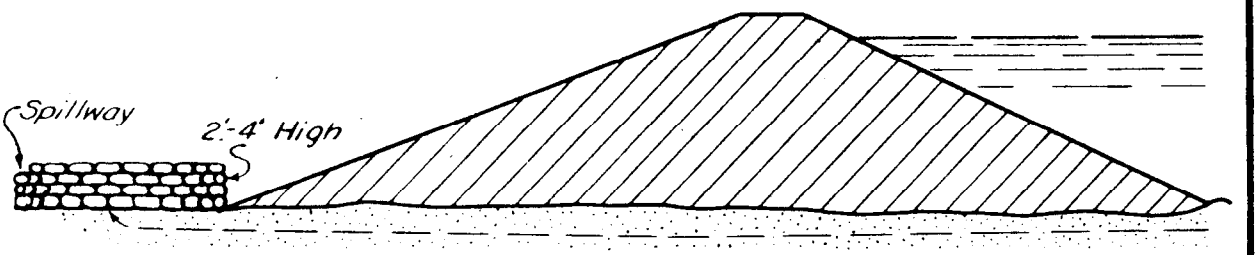
SLOUGHING OF LANDSLIDE SLOPE DUE TO RAVELLING AND UNDERCUTTING OF TOE

Fig. 2

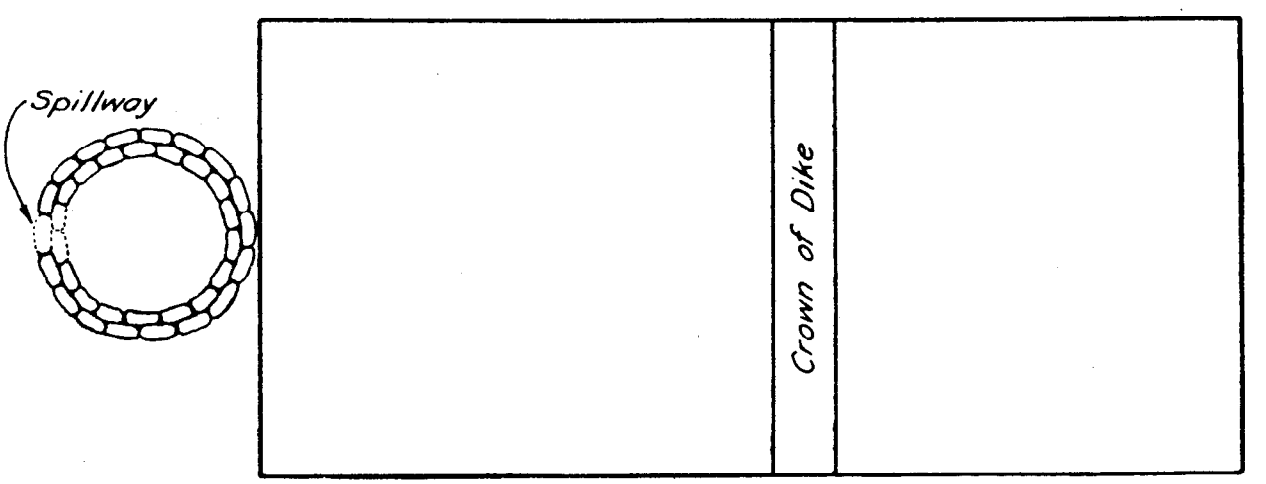


DEVELOPMENT OF SHEAR SLIDE

Fig. 3



Wall should be built on firm ELEVATION
foundation, with width of base
at least 1½ times the height.
Be sure to place sacks on ground
clear of sand discharge.
Tie into dike if boil is near toe.



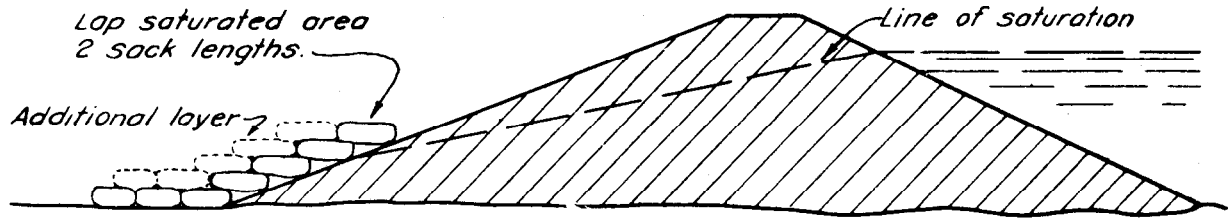
PLAN

Do not sack boil which does not put out material. Height of sack loop or ring should be only sufficient to create enough head to slow down flow through boil so that no more material is displaced and boil runs clear. Do not try to stop fully, flow through boil.

SAND BOIL
STANDARD HIGH WATER
MAINTENANCE INSTRUCTION

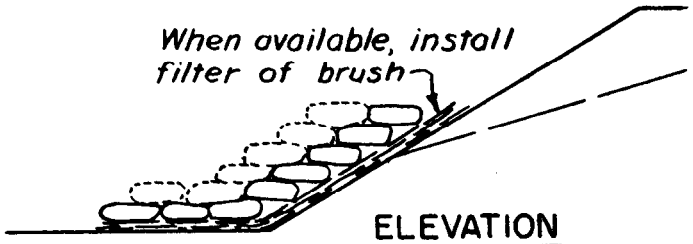
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

PLATE NO. II

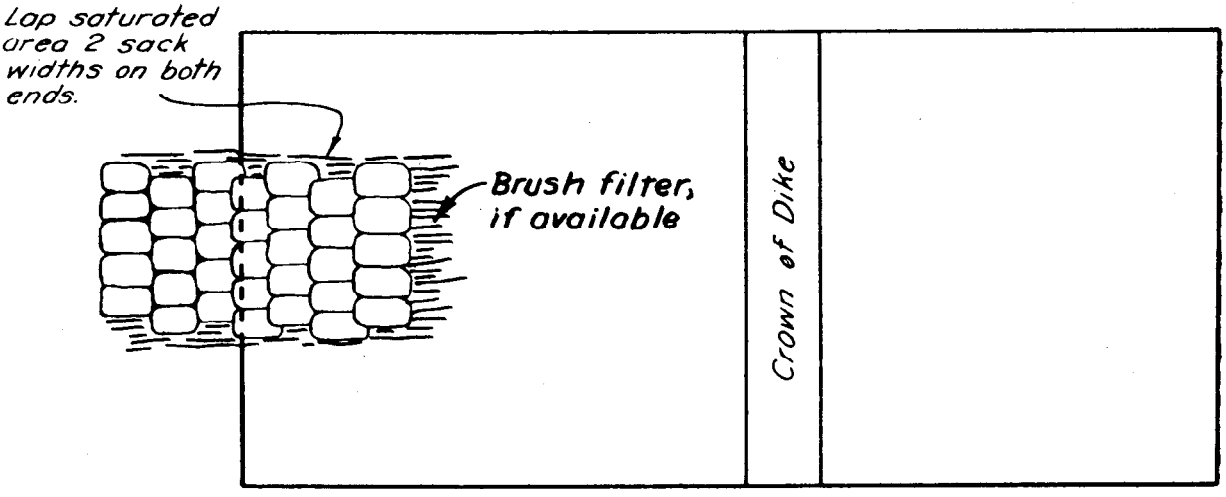


ELEVATION

Number of layers determined by velocity of seepage and amount of material being carried



ELEVATION



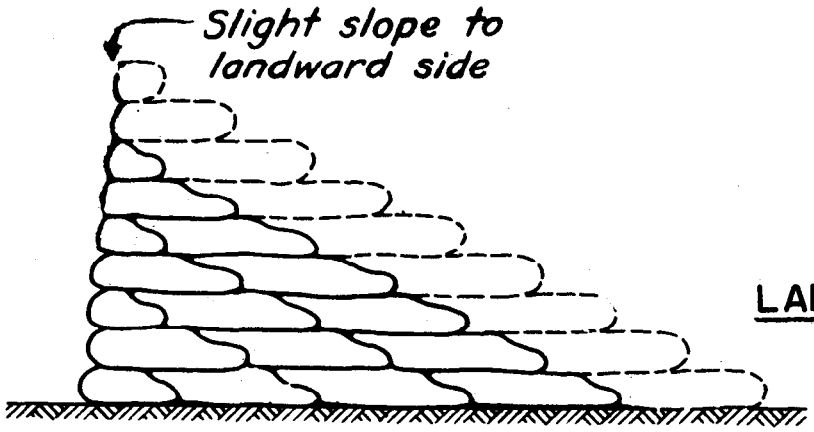
PLAN

Sacks should be laid shingle fashion and not moulded into place.

SACKING SLOUGHS
STANDARD HIGH WATER
MAINTENANCE INSTRUCTION

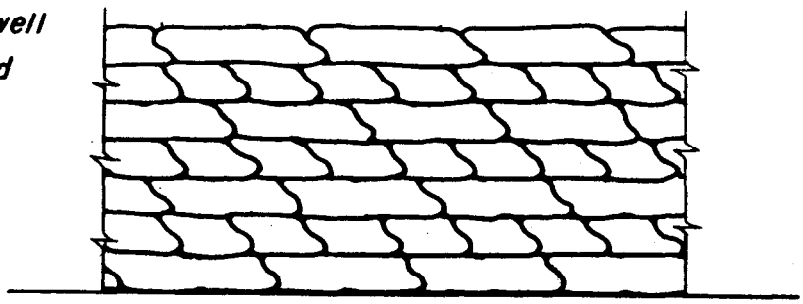
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

PLATE NO. III



SECTION

Note: Sacks should be lapped at least 1/3 all ways and well mauled or tamped into place.



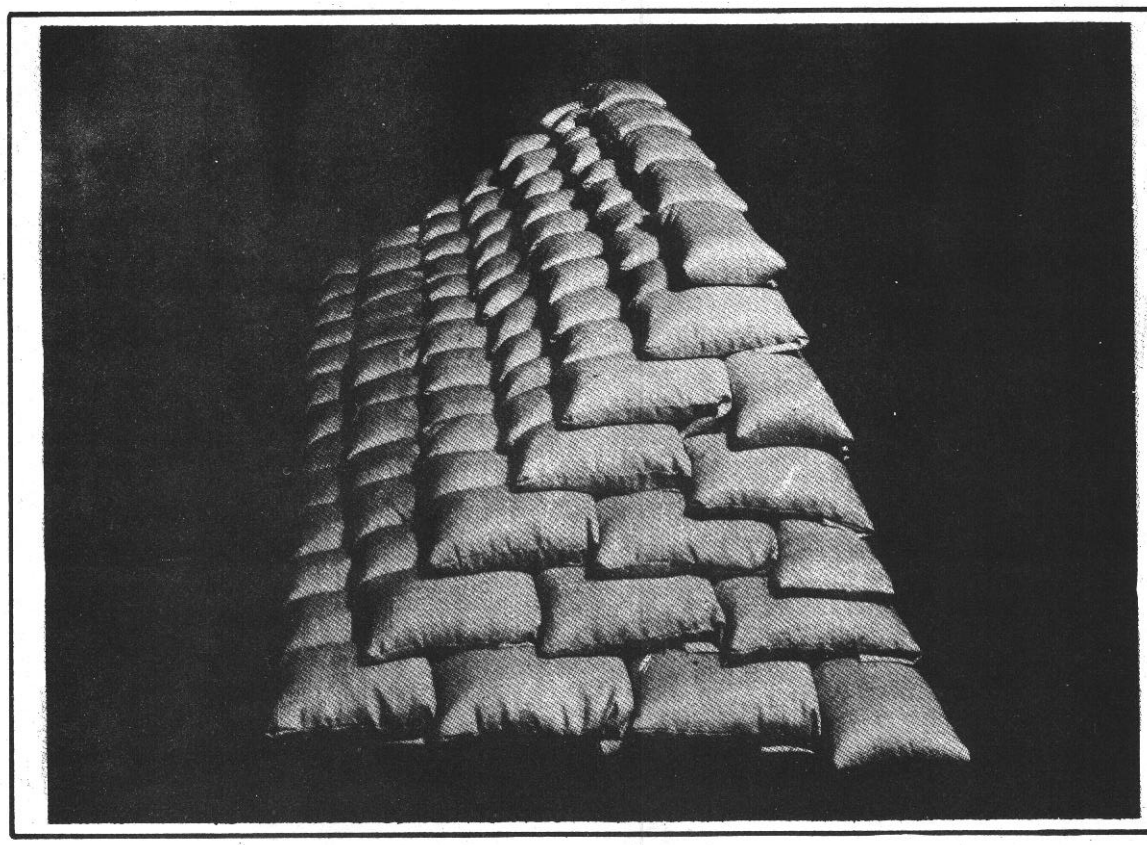
RIVERSIDE ELEVATION

SACKS REQUIRED PER 100' STA.
100 lb. "Feed" Sacks - 1 Cu. Ft. Each

Approx. Hgt. Sack Dike	Sacks High	Required
1.5	3	300
2.0	4	750
3.0	6	1400
4.0	8	2250
5.0	10	3250
6.0	12	4500
7.0	14	5950
8.0	16	7600

SACK DIKE OR TOPPING STANDARD HIGH WATER MAINTENANCE INSTRUCTION

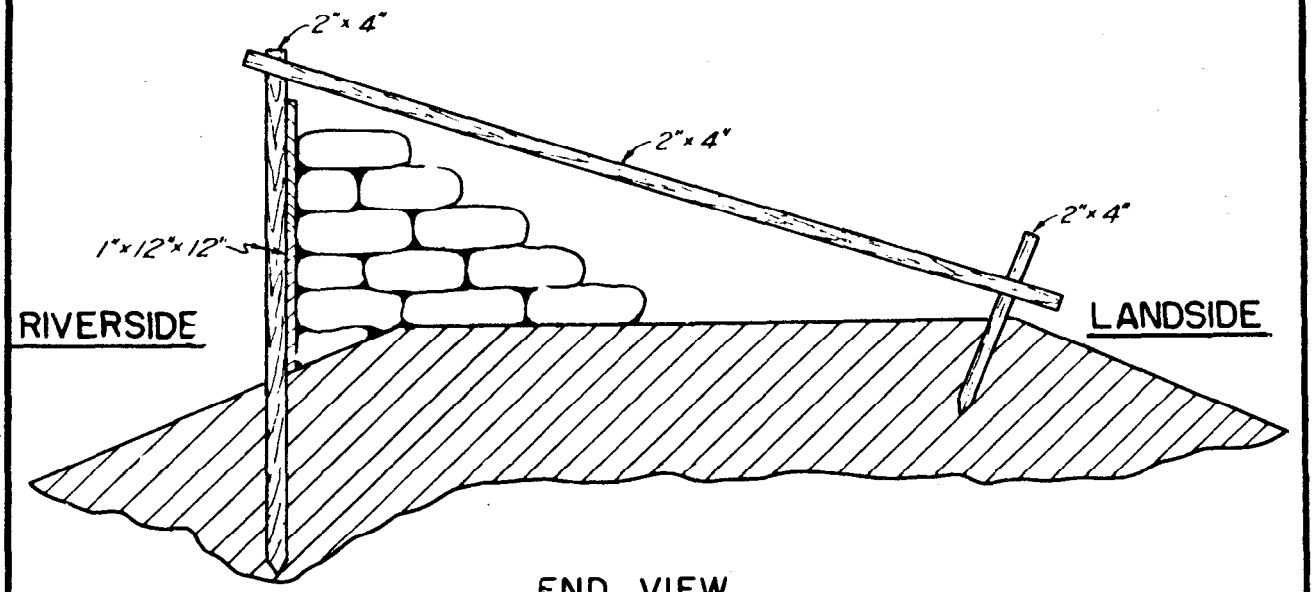
U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.



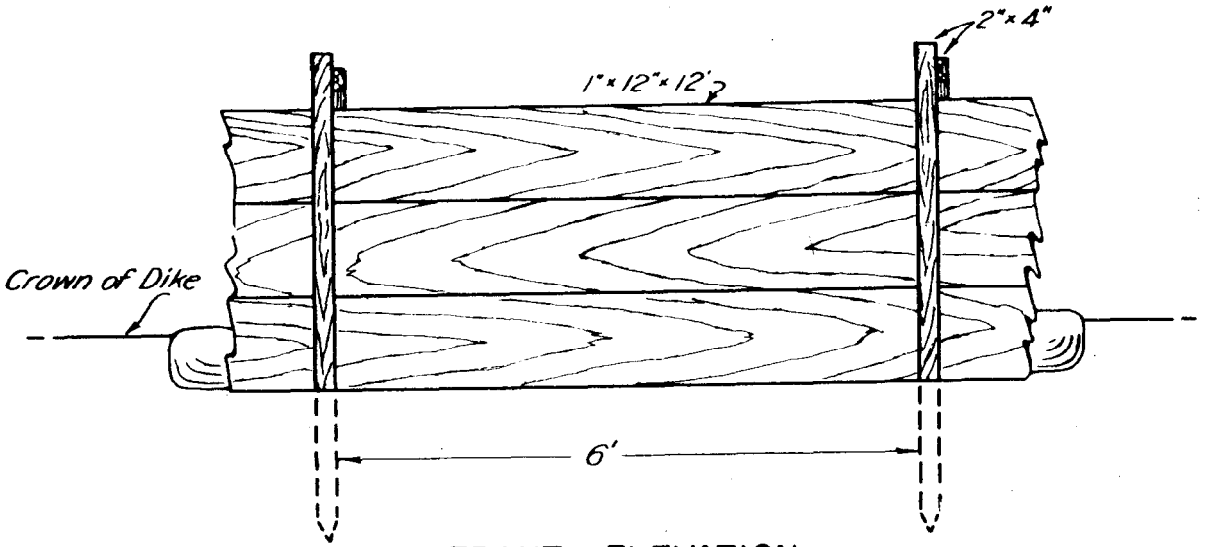
MODEL SACK DIKE OR TOPPING
Typical Section

MODEL SACK DIKE OR TOPPING
Riverside View

PLATE NO. V



END VIEW



FRONT ELEVATION

BILL OF MATERIAL TO CONSTRUCT 100 FEET

25 pcs. 1"x12"x12'	17 pcs. 2"x4"x6'
17 pcs. 2"x4"x10'	17 pcs. 2"x4"x2'

LUMBER AND SACK TOPPING STANDARD HIGH WATER MAINTENANCE INSTRUCTION

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.

PLATE NO. VI

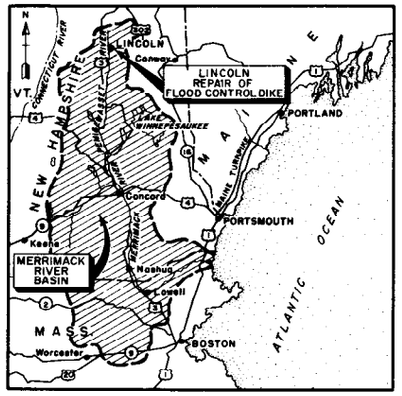
APPENDIX E

AS-BUILT DRAWINGS

Drawing No.	Title	Sheet No.
MER-1-1390	Location Plan	1
MER-1-1404	General Plan & Section	2
MER-1-1405	Detailed Plan & Sections	3

CORPS OF ENGINEERS

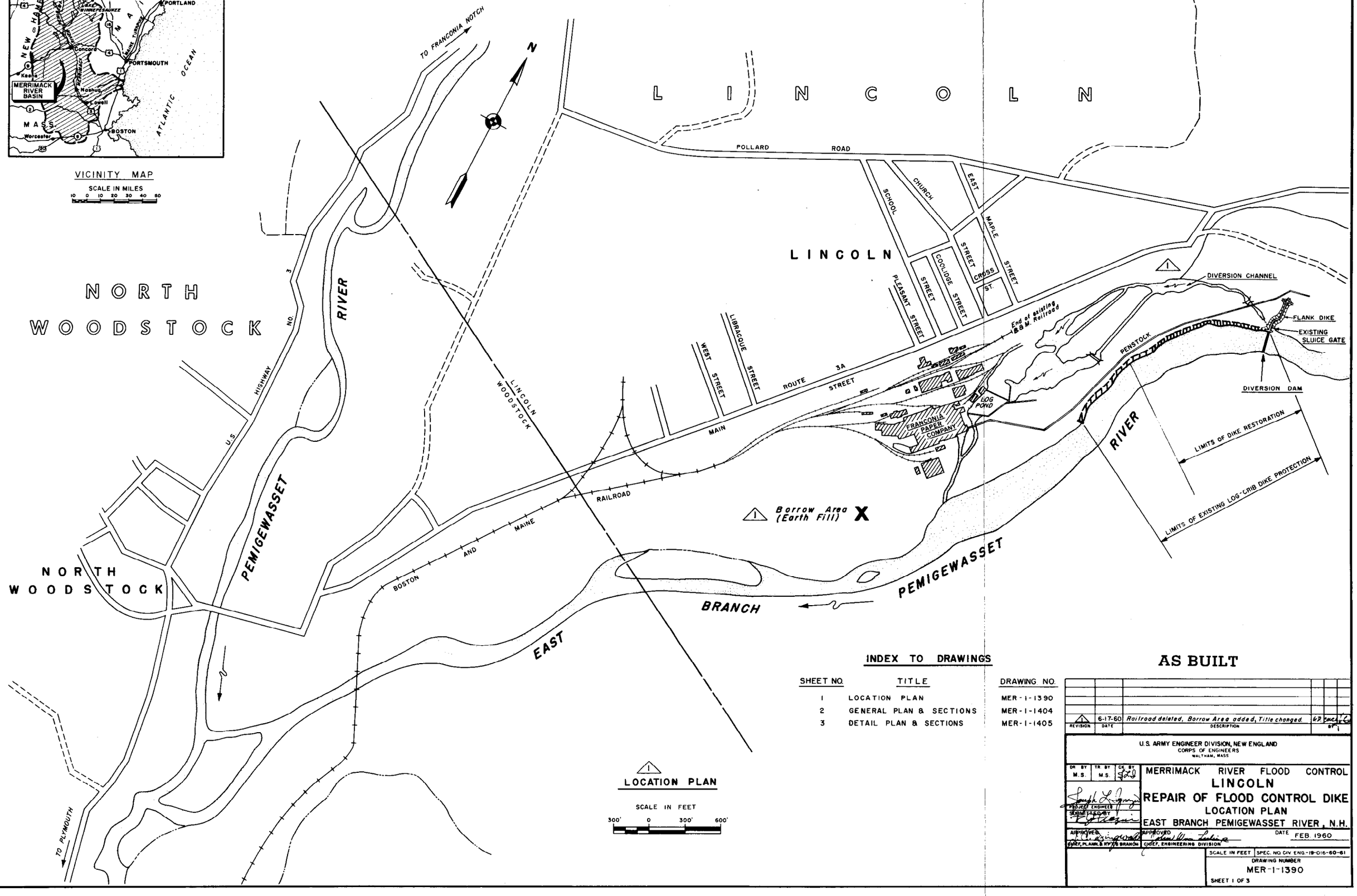
U. S. ARMY



VICINITY MAP

SCALE IN MILES

10 0 10 20 30 40 50



1 LOCATION PLAN

SCALE IN FEET

300' 0 300' 600'

INDEX TO DRAWINGS

SHEET NO.	TITLE	DRAWING NO.
1	LOCATION PLAN	MER-1-1390
2	GENERAL PLAN & SECTIONS	MER-1-1404
3	DETAIL PLAN & SECTIONS	MER-1-1405

AS BUILT

REVISION	DATE	DESCRIPTION	BY
1	6-17-60	Railroad deleted, Borrow Area added, Title changed.	GP

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

DR BY M.S. | TR BY M.S. | CK BY

PROJECT ENGINEER

SUBMITTED BY

APPROVED
CHIEF, PLANNING & REPORTS BRANCH

APPROVED
CHIEF, ENGINEERING DIVISION

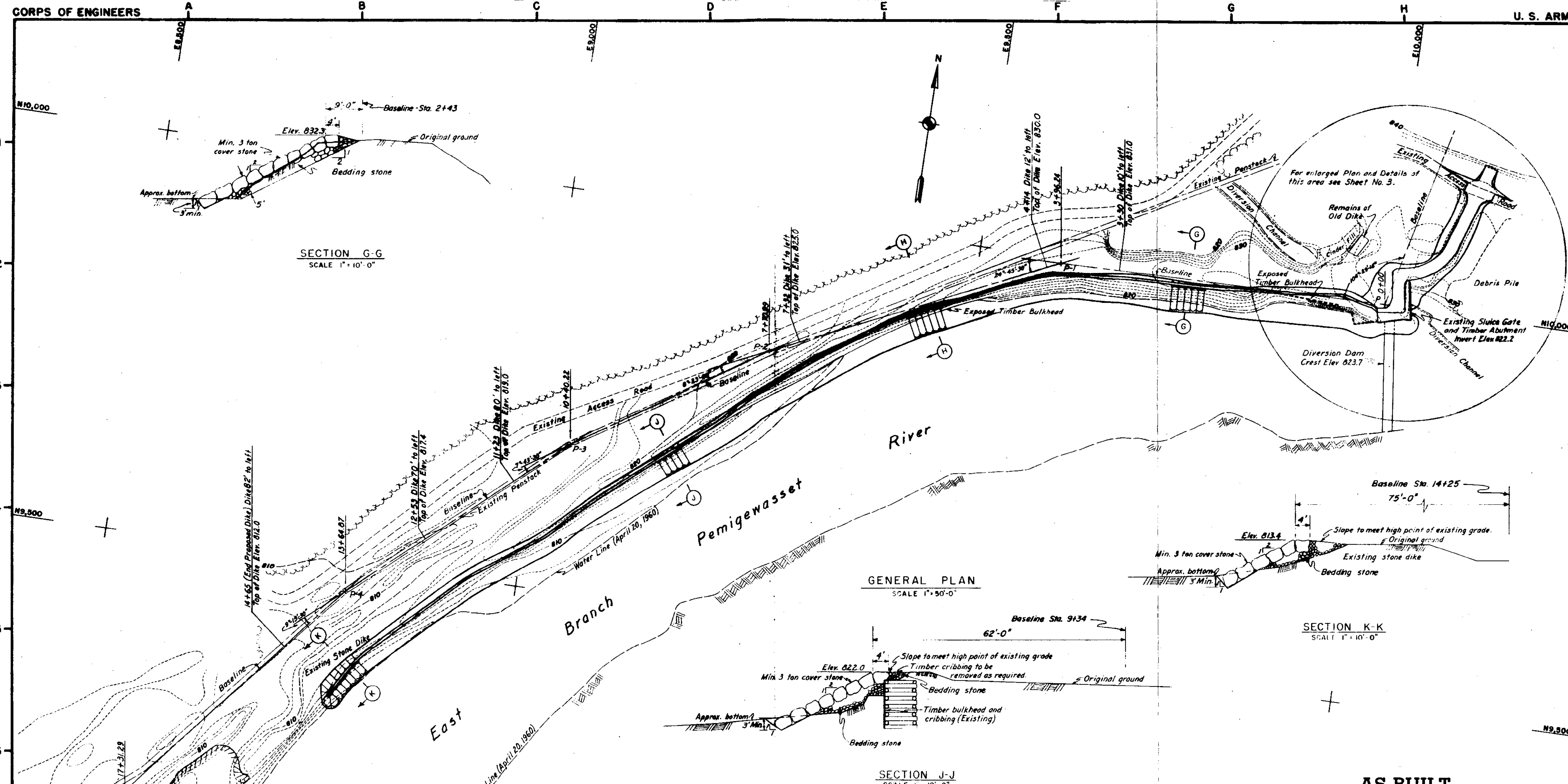
DATE FEB. 1960

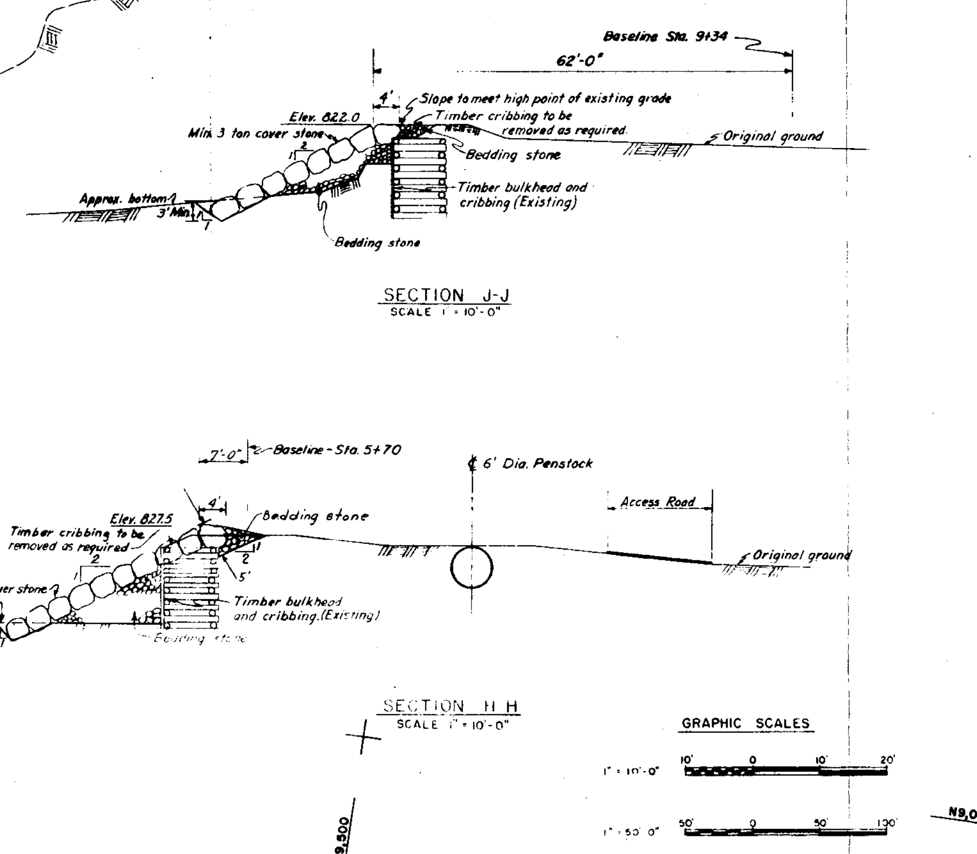
MERRIMACK RIVER FLOOD CONTROL
LINCOLN
REPAIR OF FLOOD CONTROL DIKE
LOCATION PLAN
EAST BRANCH PEMIGEWASSET RIVER, N.H.

SCALE IN FEET | SPEC. NO. DIV ENG-19-016-60-61

DRAWING NUMBER
MER-1-1390

SHEET 1 OF 3





AS BUILT

NOTES:

Elevations refer to Mean Sea Level Datum.

Contour interval is 2 feet.

Placing of spoil material shall start at the upstream end of the spoil area.

Top elevation of spoiled material shall not exceed 810.

All offsets to dike are at right angles to the baseline and are measured to the far face of the top stone.

Excavations for toe embedment of cover stone and bedding stone shall be carried to the depths indicated or to top of rock ledge if rock ledge is encountered.

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY C.N.C. DR. BY C.T.M.

C. N. Ciriello — PROJECT ENGINEER

SUBMITTED BY: CHIEF, SMALL PROJ. SEC.

APPROVAL RECOMMENDED: CHIEF, P. & R. BRANCH

APPROVED: CHIEF, ENGINEERING DIVISION

MERRIMACK RIVER FLOOD CONTROL
LINCOLN
REPAIR OF FLOOD CONTROL DIKE
GENERAL PLAN & SECTIONS
EAST BRANCH PEMIGEWASSET RIVER N.H.

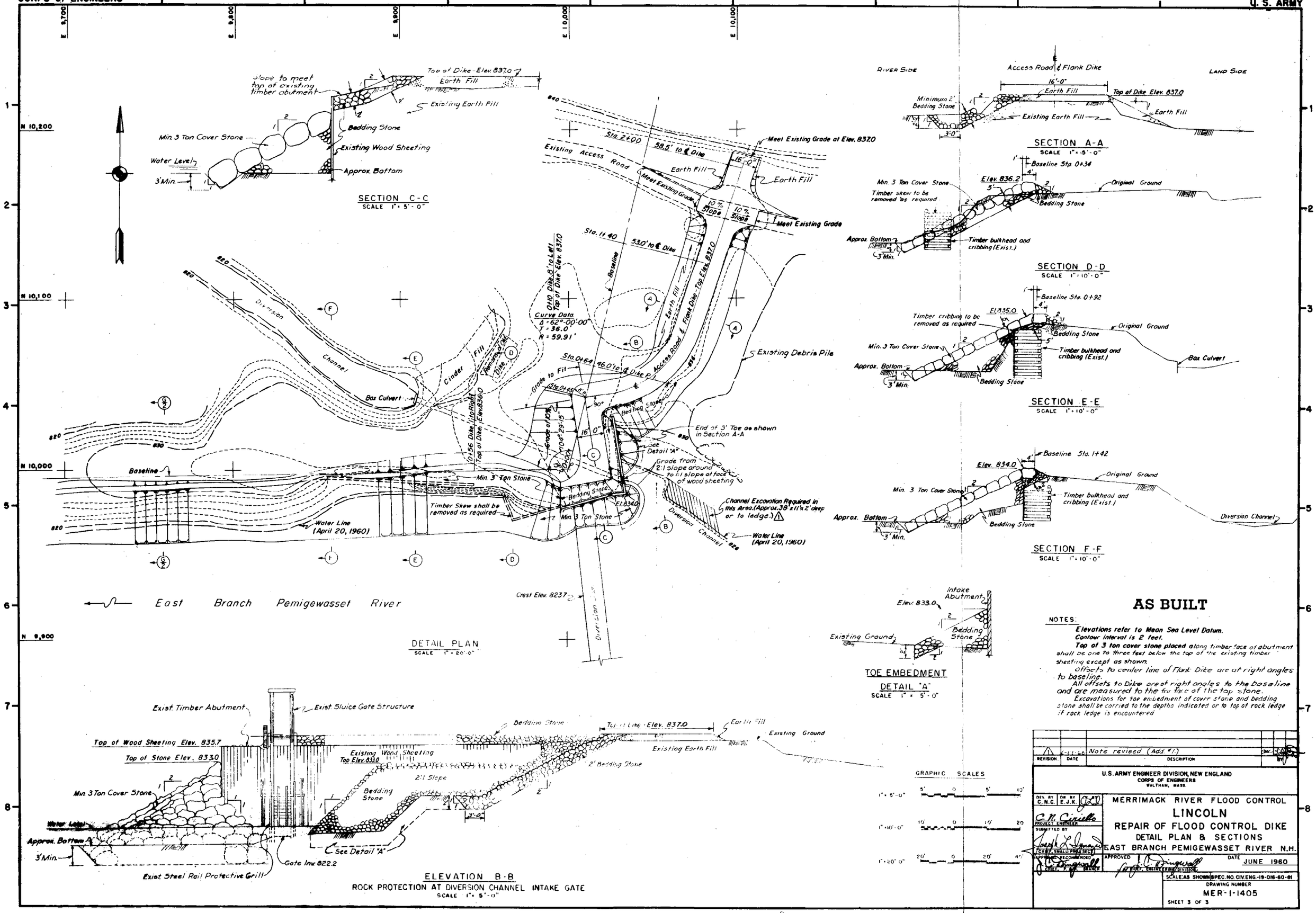
DATE JUNE 1960

SCALE: AS SHOWN | SPEC. NO. CIV. ENG.-19-016-60-61

DRAWING NUMBER MER - 1 - 1404

SHEET 2 OF 3

CORPS OF ENGINEERS — U. S. ARMY



AS BUILT

NOTES:

Elevations refer to Mean Sea Level Datum.

Contour interval is 2 feet.

Top of 3 ton cover stone placed along timber face of abutment shall be one to three feet below the top of the existing timber sheeting except as shown.

Offsets to center line of Flank Dike are at right angles to baseline.

All offsets to Dike are at right angles to the Baseline and are measured to the toe face of the top stone.

Excavations for toe embedment of cover stone and bedding stone shall be carried to the depths indicated or to top of rock ledge if rock ledge is encountered.

GRAPHIC SCALES

1" = 5'-0" — 5' 0 5' 10'

1" = 10'-0" — 10' 0 10' 20'

1" = 20'-0" — 20' 0 20' 40'

REVISION	DATE	DESCRIPTION	BY
1	4-11-60	Note revised (Add. #1)	GHC

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY C.N.C. | DR. BY E.J.K.

C.N. Ciriello
PROJECT ENGINEER

SUBMITTED BY
CHIEF, SMALL PROJ. SECT.

APPROVAL RECOMMENDED
CHIEF, ENGR. BRANCH

APPROVED
CHIEF, ENGINEERING DIVISION

DATE JUNE 1960

MERRIMACK RIVER FLOOD CONTROL
LINCOLN
REPAIR OF FLOOD CONTROL DIKE
DETAIL PLAN & SECTIONS
EAST BRANCH PEMIGEWASSET RIVER N.H.

SCALE AS SHOWN | SPEC. NO. CIV. ENG.-19-016-60-81

DRAWING NUMBER
MER-1-1405

SHEET 3 OF 3